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Watkins

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(54) **APPLIANCE WITH A VENTURI BASED VENTING SYSTEM**

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(51) **Int. Cl.**

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F24C 15/34	(2006.01)
F24B 5/08	(2006.01)
A47J 37/06	(2006.01)

(52) **U.S. Cl.** ..... **126/21 A**; 126/1 R; 126/19 R; 126/21 R; 126/273 R; 126/273.5; 126/275 E

(58) **Field of Classification Search** ..... 126/1 R, 126/19 R, 21 A, 21 R, 273 R, 273.5, 275 E
See application file for complete search history.

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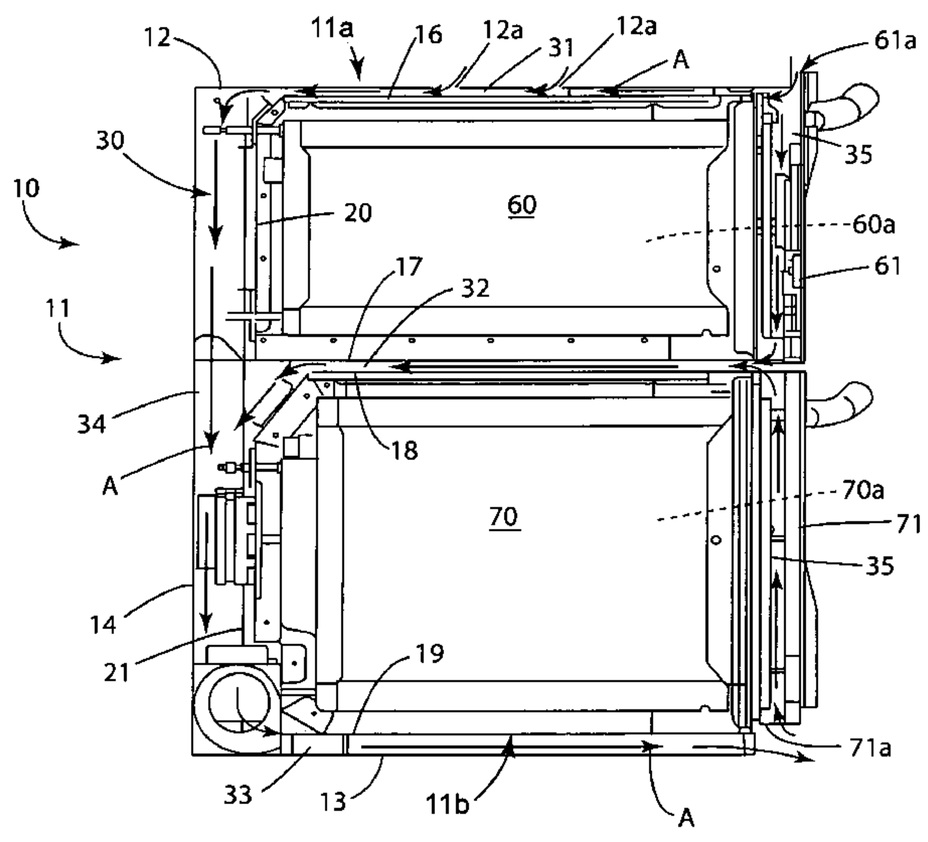
(57) **ABSTRACT**

An appliance with a Venturi based venting system is disclosed. The appliance includes a housing defining an airflow channel in flow communication with outside of the appliance, the airflow channel having a common channel with a diverging section; first and second heating units disposed in the housing; a first duct through which a first cavity of the first unit is in flow communication with the common channel, the first duct having a first outlet end disposed at least partially in the diverging section; a second duct through which a second cavity of the second unit is in flow communication with the common channel, the second duct having a second outlet end disposed in the diverging section; and a fan in flow communication with the common channel.

14 Claims, 9 Drawing Sheets



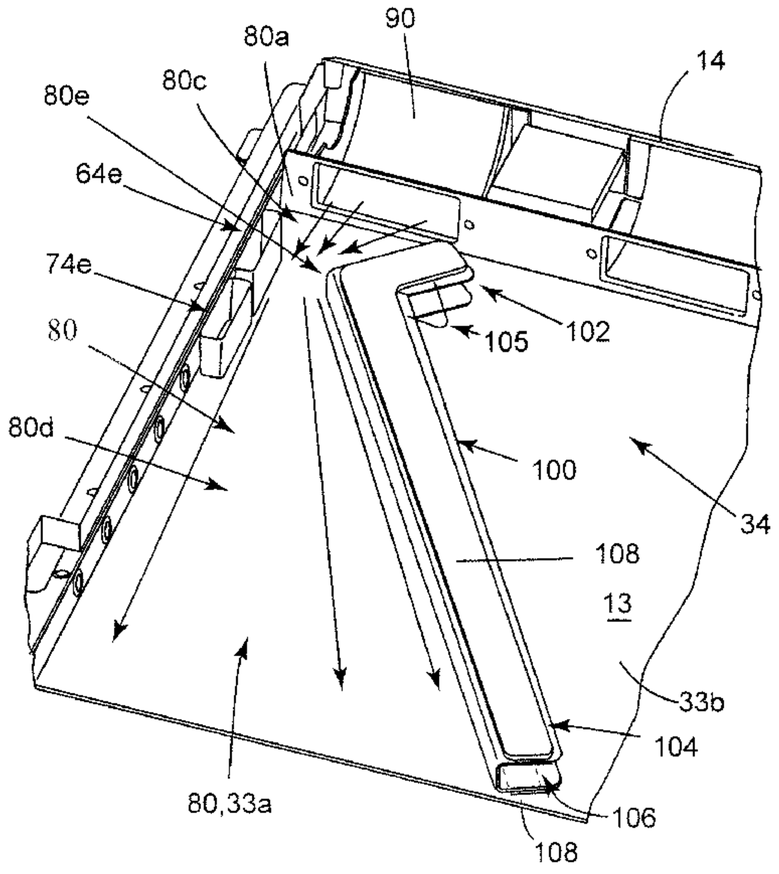
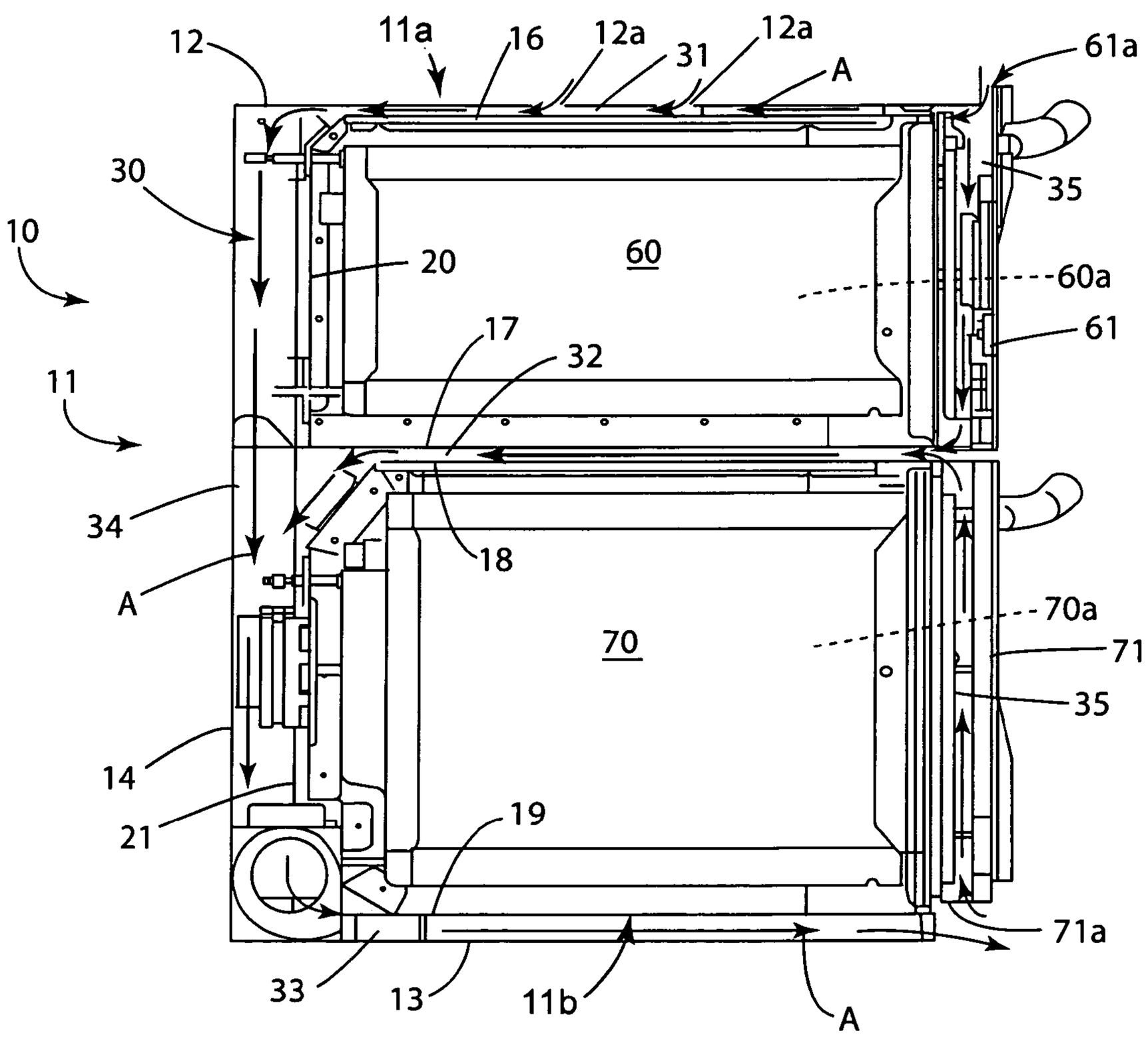


FIG. 1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70a
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19
71a
33
13
11b
A

FIG. 2

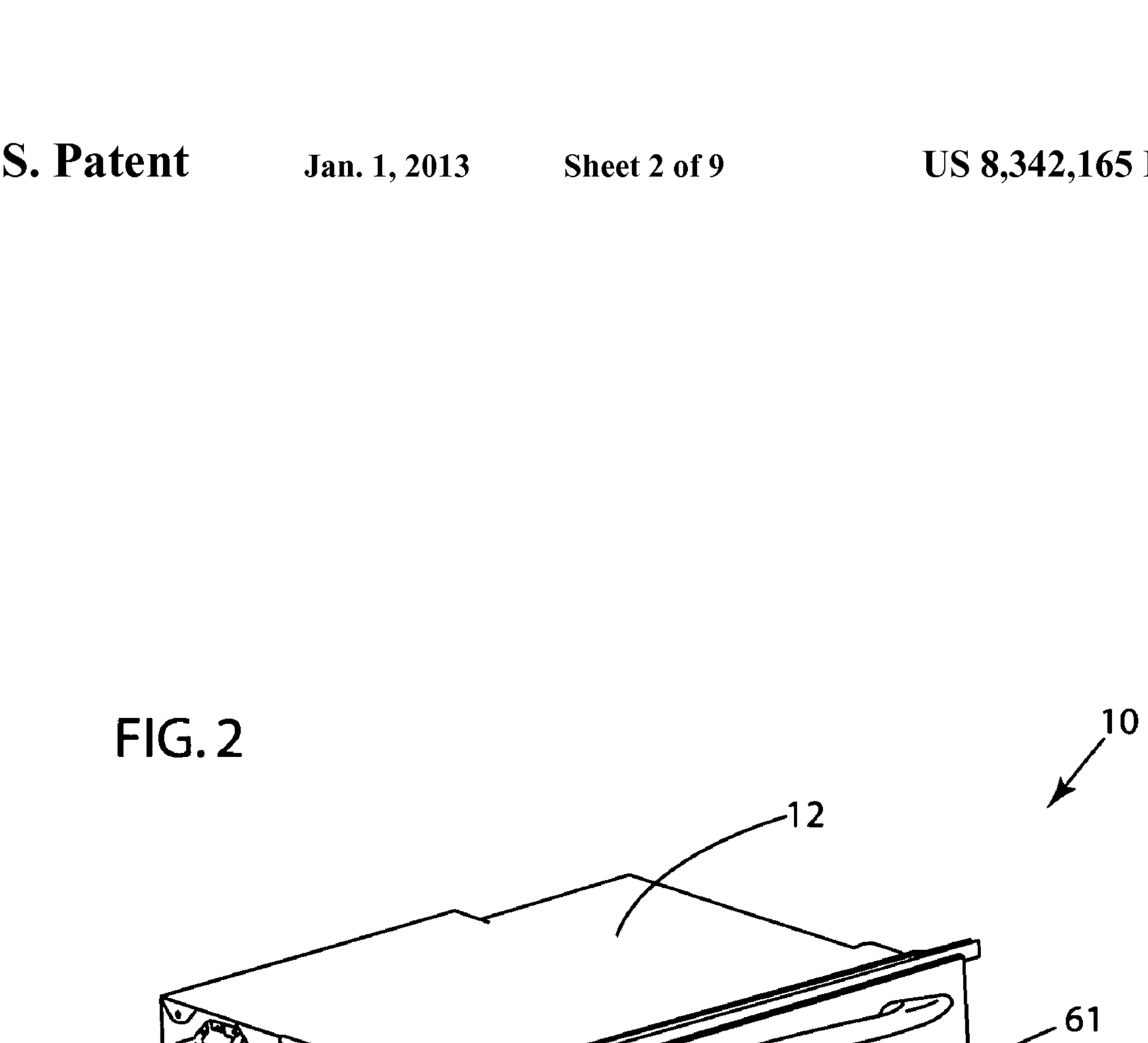


FIG. 3

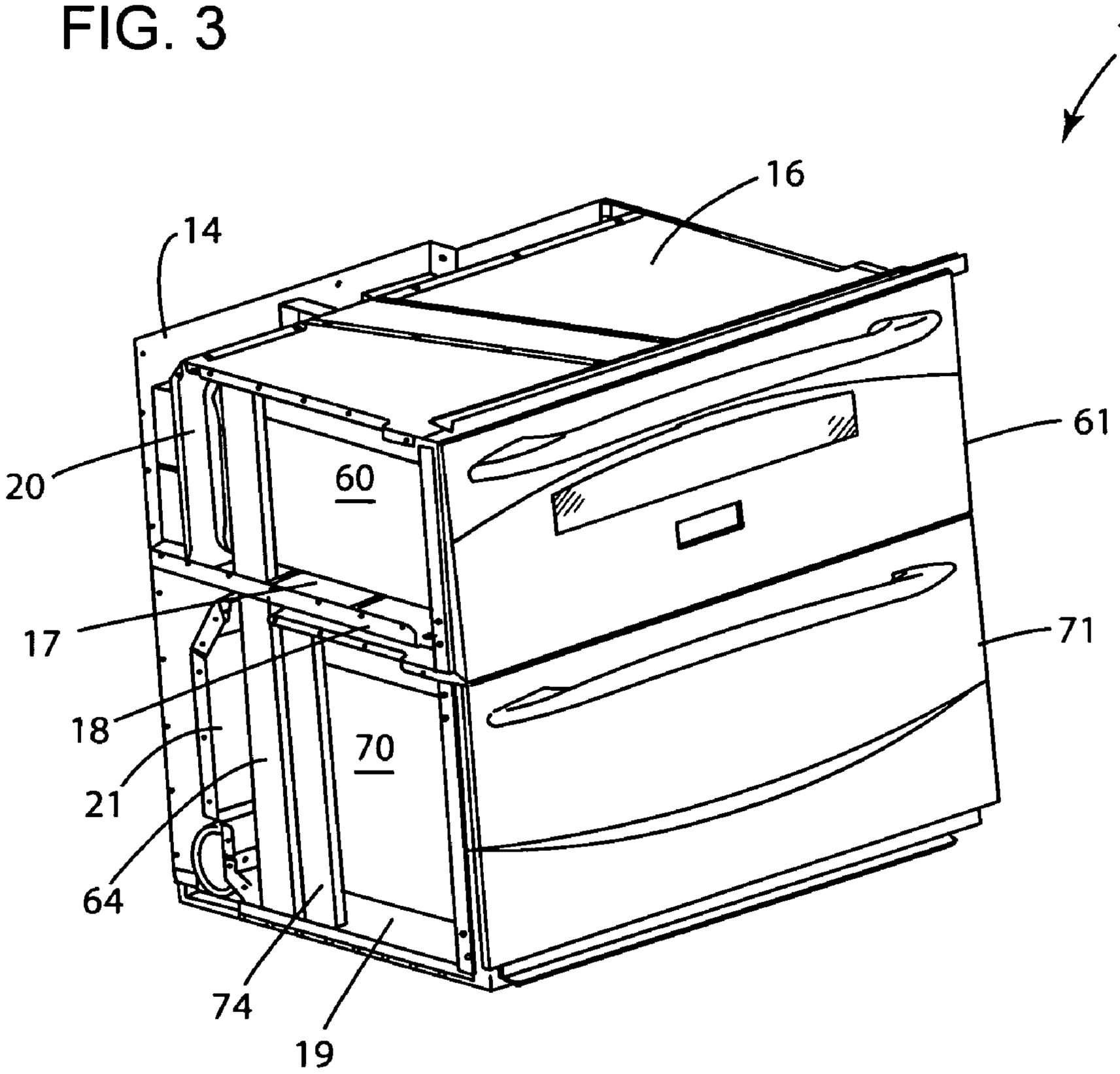


FIG. 4

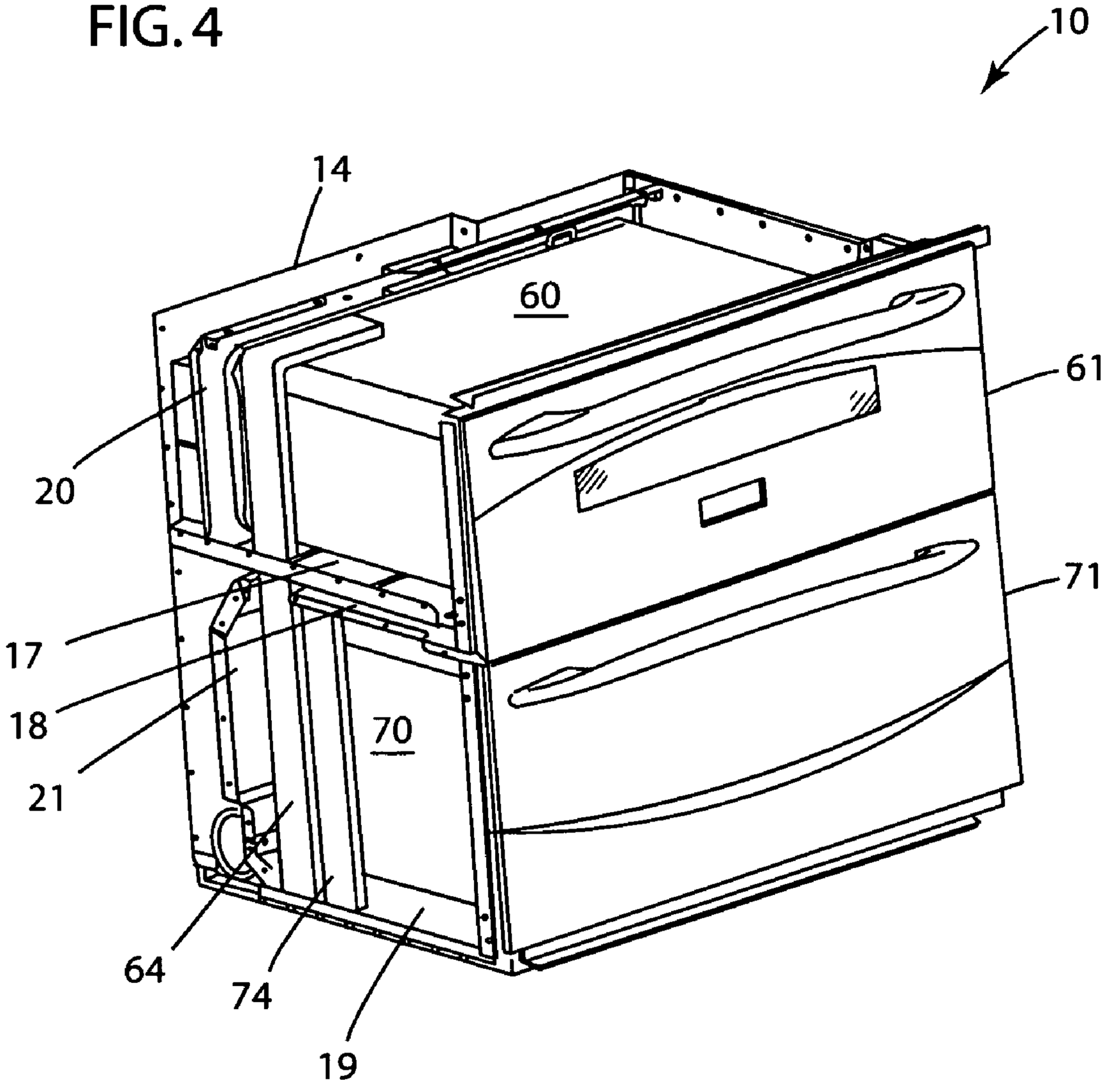


FIG. 5

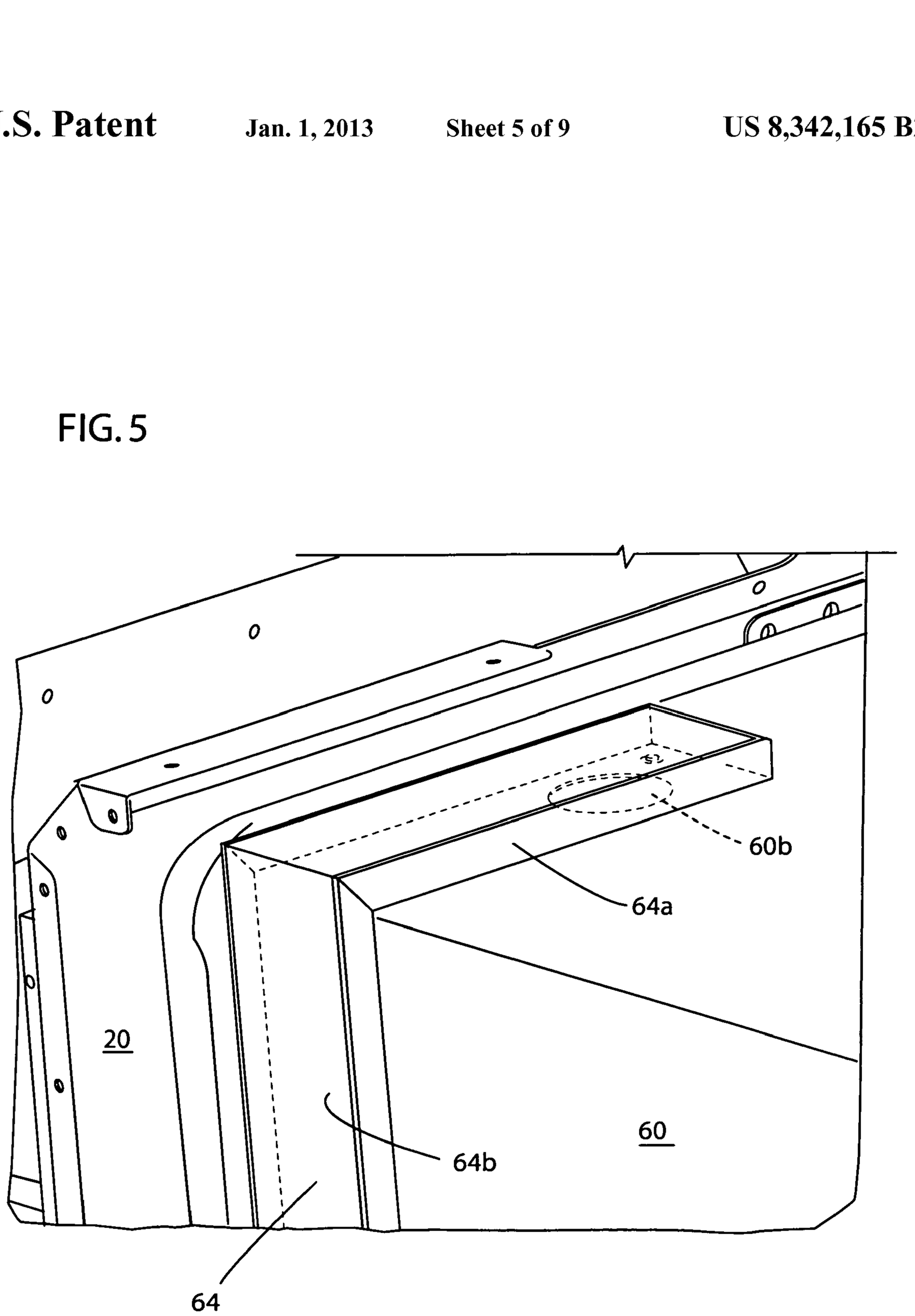


FIG. 6

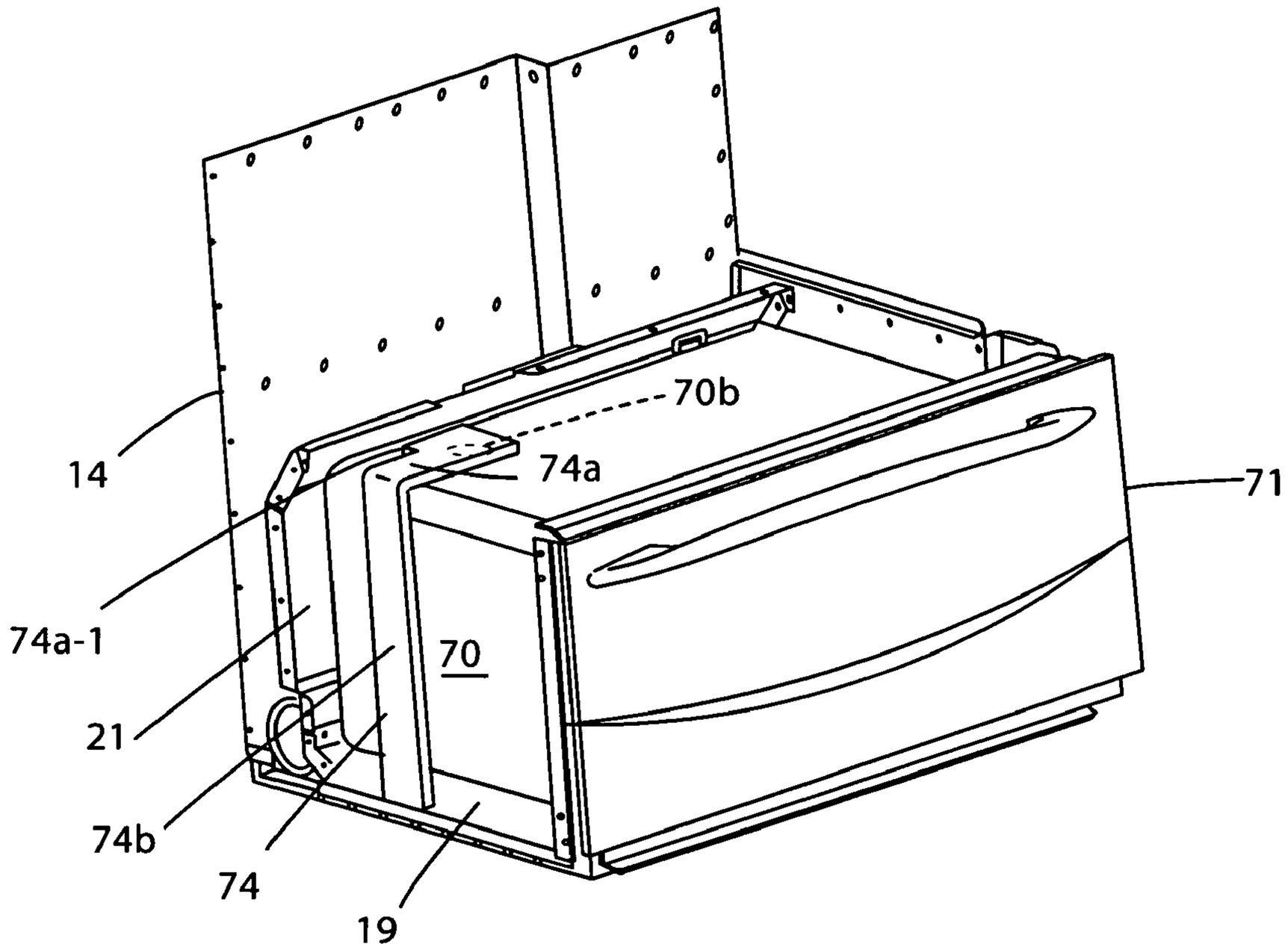


FIG. 7

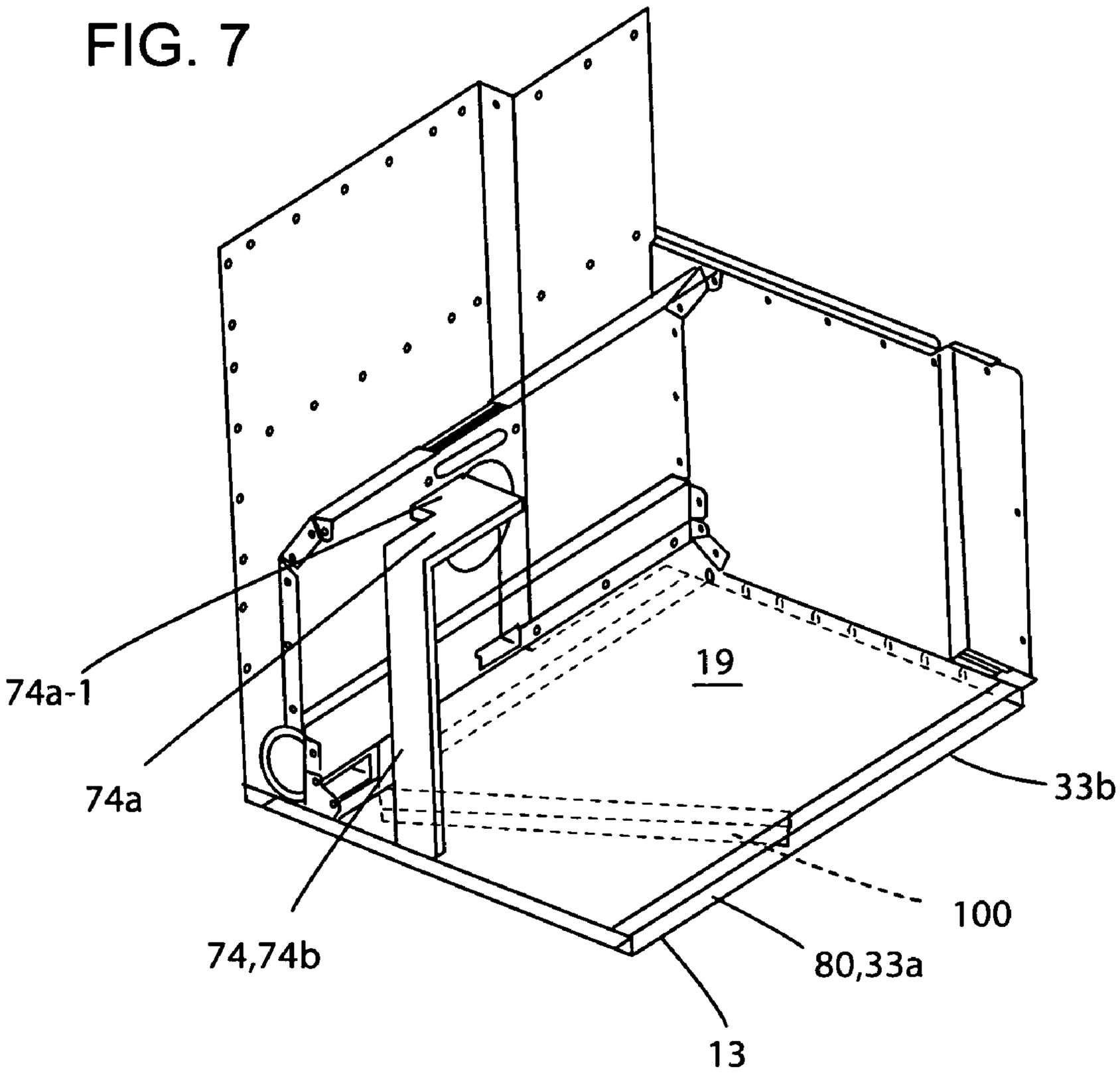
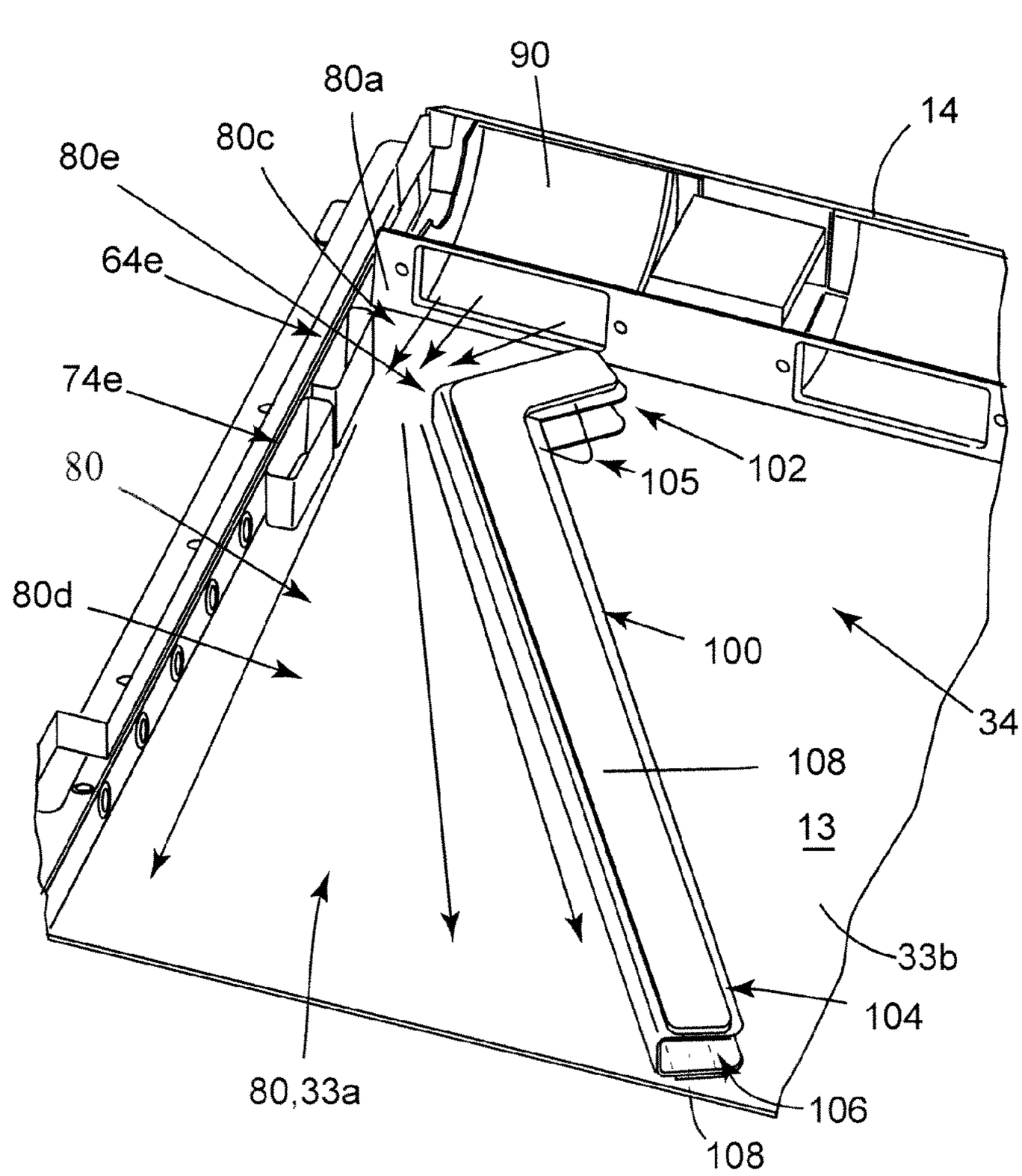


FIG. 8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80a
80c
80e
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64e
74e
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80d
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102
100
34
108
13
33b
104
106
108
80,33a

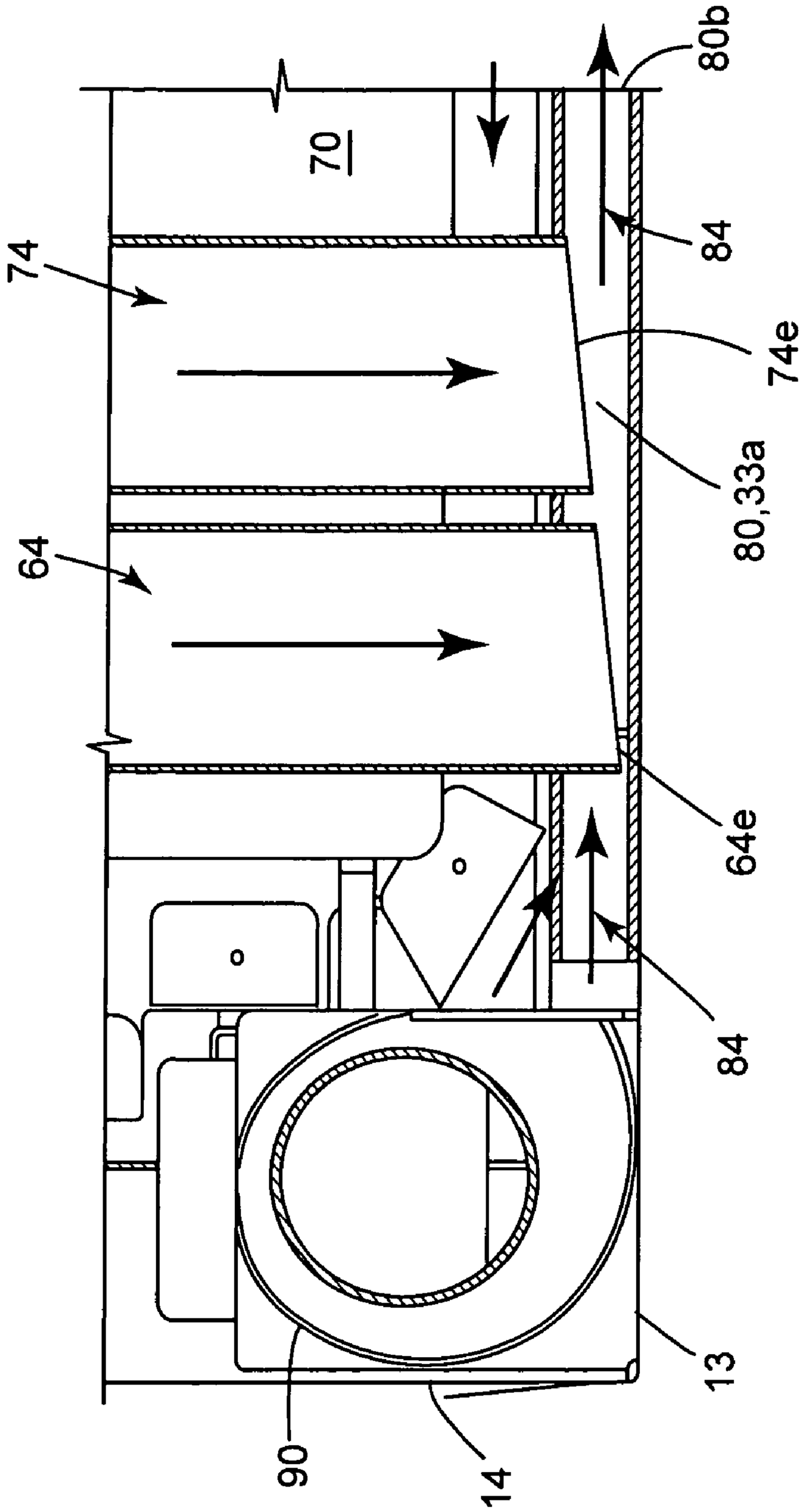

FIG. 9

APPLIANCE WITH A VENTURI BASED VENTING SYSTEM

BACKGROUND OF THE INVENTION

The present invention relates generally to an appliance. More particularly, the present invention relates to an appliance with a Venturi based venting system.

Dual-cavity wall oven appliances typically draw in ambient or cooling air via air intakes located at the front of the appliance above the upper oven cavity or below the lower oven cavity. Additionally, each oven unit is typically cooled by a fan independently of the other oven unit. The fan can also be used to draw exhaust air out of the respective oven cavity. The fans may blow the air down the back of the oven units. The exhaust air for this type of system is usually evacuated at locations between the upper and lower oven units and also below the lower oven unit on the front side of the oven.

Moreover, typically the exhaust air passes through the fans before it exits the oven.

One disadvantage of the current oven design is that because the exhaust air passes through the fans, undesirable substances such as greases, moistures, etc. may accumulate on the fans, negatively affecting the fans' reliability and/or performance. Another disadvantage of the current oven design is that the use of multiple fans decreases the reliability, and increases the expense and complexity of such venting system. Yet another disadvantage of the current oven design is that the exhaust air, after heated by the oven units, contacts the fans. Such contact is undesirable as the heat from the exhaust air heats up the fans. The fans can be negatively affected as they are heated up beyond the optimal operational temperature range, which may lead to underperformance, damage or complete failure of the fans.

It would therefore be desirable to provide an appliance with a venting system wherein the undesirable exhaust air does not pass through the fans. It would also be desirable to provide an appliance with a venting system which uses a single fan to provide the venting power.

BRIEF DESCRIPTION OF THE INVENTION

As described herein, the preferred embodiments of the present invention overcome one or more of the above or other disadvantages known in the art.

One aspect of the invention relates to an appliance which includes a housing defining therein an airflow channel which is in flow communication with outside of the appliance, the airflow channel including a common channel comprising a diverging section; a first heating unit disposed in the housing, the first heating unit defining therein a first cavity; a second heating unit disposed in the housing, the second heating unit defining therein a second cavity; a first duct through which the first cavity is in flow communication with the common channel, the first duct having a first outlet end disposed at least partially in the diverging section; a second duct through which the second cavity is in flow communication with the common channel, the second duct having a second outlet end disposed in the diverging section; and a fan in flow communication with the common channel. When energized, the fan generates an airflow in the common channel to create a Venturi effect in the diverging section so that exhaust air in the first and second cavities is drawn into the common channel.

Another aspect of the invention relates to an appliance which includes a housing defining therein an airflow channel which is in flow communication with outside of the appliance, the airflow channel including a common channel with an intake end, an exhaust end and a diverging section between the intake end and the exhaust end; a first oven disposed in the housing, the first oven defining therein a first oven cavity; a

second oven disposed in the housing, the second oven defining therein a second oven cavity; a first duct through which the first oven cavity is in flow communication with the common channel, the first duct having a first outlet end terminating in the diverging section; a second duct through which the second oven cavity is in flow communication with the common channel, the second duct having a second outlet end terminating in the diverging section; and a fan in flow communication with the common channel and disposed upstream of the first and second outlet ends. When energized, the fan generates an airflow in the common channel to generate a Venturi effect in the diverging section so that exhaust air in the first and second oven cavities is drawn into the common channel through the first and second ducts.

These and other aspects and advantages of the present invention will become apparent from the following detailed description considered in conjunction with the accompanying drawings. It is to be understood, however, that the drawings are designed solely for purposes of illustration and not as a definition of the limits of the invention, for which reference should be made to the appended claims. Moreover, the drawings are not necessarily drawn to scale and that, unless otherwise indicated, they are merely intended to conceptually illustrate the structures and procedures described herein.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. **1** is a schematic, cross sectional side elevational view of an exemplary dual-cavity oven incorporating an embodiment of a venting system of the present invention;

FIG. **2** is a perspective, partially cut-away view of the oven of FIG. **1**, with some components of the oven being removed to show the first and second ducts;

FIG. **3** is a perspective, partially cut-away view of the oven of FIG. **1**, with the top wall being also removed;

FIG. **4** is a perspective, partially cut-away view of the oven of FIG. **1**, with the top insulation retention element and the insulation material for the upper oven being removed;

FIG. **5** is an enlarged, perspective, partially cut-away view of part of the oven of FIG. **1**, showing the top section of the first duct in detail;

FIG. **6** is a perspective, partially cut-away view of the oven of FIG. **1**, showing the lower oven unit and the second duct in detail;

FIG. **7** is a perspective, partially cut-away view of the oven of FIG. **1**, showing the second duct and the common channel in detail;

FIG. **8** is an enlarged, perspective, cut-away view of the oven of FIG. **1**, showing the angular guide member and the bottom channel including the common channel in detail; and

FIG. **9** is an enlarged, partially, cross sectional side elevation view of the bottom portion of the oven of FIG. **1**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS OF INVENTION

Referring to FIGS. **1-7**, an exemplary appliance such as a dual-cavity oven incorporating a preferred embodiment of a Venturi based venting system in accordance with the present invention is generally designated by reference numeral **10**. The dual-cavity oven **10** has a housing **11** which includes an outer case **11***a* comprised of a top wall **12**, a bottom wall **13**, a back wall **14** and two sidewalls (not shown in FIG. **1**).

Disposed in the housing **11** are a first heating unit such as a first oven **60** and a second heating unit such as a second oven **70**, which is positioned below the first oven **60**. The first oven **60** defines therein a first oven cavity **60***a* with a frontal open-

ing (not shown). A first door **61** is pivotally attached to the housing **11** in a known manner for selectively closing the frontal opening of the first oven **60**. Similarly, the second oven **70** defines therein a second oven cavity **70***a* with a frontal opening (not shown), and a second door **71** is pivotally attached to the housing **11** in a known manner for selectively closing the frontal opening of the first oven **70**.

The housing **11** also includes an inner case or insulation retention structure **11***b*. More specifically, as shown in FIGS. **1** and **4**, the insulation retention structure **11***b* includes a first retention member **16** disposed between the top wall **12** and the first oven **60**, a second retention member **17** disposed between the first and second ovens **60**, **70**, a third retention member **18** disposed between the second retention member **17** and the second oven **70**, a fourth retention member **19** disposed between the bottom wall **13** and the second oven **70**, a fifth retention member **20** disposed between the back wall **14** and the first oven **60**, a sixth retention member **21** disposed between the back wall **14** and the second oven **70**, and two side retention members (not shown in FIG. **1**) each disposed between a respective sidewall of the outer case **11***a* and the first and second oven **60**, **70**. As is known in the art, the space defined between the insulation retention structure **11***b* and each of the first and second oven **60**, **70** is preferably filled with a thermally insulating material such as fiberglass. The insulation retention structure **11***b* keeps the thermally insulating material in place.

As clearly illustrated in FIG. **1**, the housing defines therein an airflow channel **30** which includes a first or top channel **31** defined by the top wall **12** and the first retention member **16**, a second or middle channel **32** defined by the second and third retention members **17**, **18**, a third or bottom channel **33** defined by the bottom wall **13** and the fourth retention member **19**, and a fourth or back channel **34** generally defined between the back wall **14** and the fifth and sixth retention members **20**, **21**. Preferably, the back channel **34** is in flow communication with the bottom channel **33** through a fan unit **90**. Moreover, preferably, each of the doors **61**, **71** defines therein an airflow channel **35** which is in flow communication with the middle channel **32**. The top wall **12** has at least one air inlet **12***a*. The doors **61**, **71** each have an air inlet **61***a*, **71***a*. When the fan unit **90** is energized, it creates a suction force within the airflow channel **30**, which draws cooling air from the ambient into the airflow channels **30**, **35** and moves it along the airflow channels **30**, **35**, as indicated by the arrow A in FIG. **1**.

As shown in FIGS. **2-5**, a first duct **64** is used to establish a flow communication between the first oven cavity **60***a* and a common channel **80** (shown in FIG. **8**) defined in the lower channel **33**. As clearly shown in FIGS. **4** and **5**, the first duct **64** includes a first section **64***a* which covers an opening **60***b* formed on the top wall of the first oven **60** and extends outward laterally, and a second section **64***b* which extends downward, passing through the second, third and fourth retention members **17**, **18**, **19**. Similarly, a second duct **74** is used to establish a flow communication between the second oven cavity **70***a* and the common channel **80**. The second duct **74** includes a first section **74***a* which covers an opening **70***b* formed on the top wall of the second oven **70** and extends outward laterally, and a second section **74***b* which extends downward, passing through the third and fourth retention members **18**, **19**. Since the first and second ducts **64**, **74** are positioned side by side and since preferably the openings **60***a*, **70***a* are aligned with each other, the first section **74***a* of the second duct **74** has a set back portion **74***a*-**1**.

As clearly shown in FIGS. **7** and **8**, the common channel **80** is defined in part by an angular guide member such as a Venturi guide member **100** which is positioned between the bottom wall **13** and the fourth retention member **19**. More specifically, the guide member **100** divides the bottom channel **33** into a first section **33***a* which forms the common channel **80** and a second section **33***b*. The guide member **100** preferably includes a channel **106** facing away from the common channel **80**. Other angular elements may be used as guide elements to generate a Venturi effect. As explained in detail below, the guide member **100** directs the airflow **84** in the common channel **80** in a substantially divergent pattern. Preferably, a sealing element **108** is disposed on each of the top and bottom surfaces of the guide member **100**. The sealing element **108** is sandwiched by the guide member **100** and the bottom wall **13** and the fourth retention member **19**.

As illustrated in FIG. **8**, the guide member **100** is substantially V-shaped and has an angle **105** of less than 180 degrees. The angle **105** is formed by a first segment **102** and a second segment **104** and faces away from the common channel **80** so that the common channel **80** has a converging section **80***c* and a diverging section **80***d* disposed downstream of the converging section **80***c*. The common channel **80** thus is divided at the point of the "v" **80***e* of the guide member **100** where the converging section **80***c* and the diverging section **80***d* meet and where the common channel **80** has the smallest cross section. Preferably the first segment **102** is shorter than the second segment **104**. The common channel **80** has an intake end **80***a* disposed adjacent to the back of the oven **10** and an exhaust end **80***b* disposed or terminating at the front of the oven **10**.

Referring now to FIGS. **1**, **8** and **9**, the fan unit **90** is positioned in the lower, back portion of the oven **10**, behind the first and second ducts **64**, **74**, and adjacent to the intake end **80***a* of the common channel **80**. The term "fan" used herein covers electric fans, blowers, and other devices suitable for moving air. As shown in FIGS. **1**, **7** and **8**, the fan unit **90** is in flow communication with the back channel **34**, the common channel **80** and the second section **33***b* of the bottom channel **33**. The fan unit **90** actually has two fans, one for the common channel **80**, the other for the second section **33***b* of the bottom channel **33**. When energized, the fan unit **90** generates the airflow **84** in the common channel **80**. The fan unit **90** is positioned upstream of the outlet ends **64***e*, **74***e* of the first and second ducts **64**, **74**. As explained in detail below, the airflow **84** is used to draw exhaust air from the first and second oven cavities **60***a*, **70***a* into the common channel **80** through the first and second ducts **64**, **74**, respectively.

As clearly shown in FIG. **9**, the outlet ends **64***e*, **74***e* of the first and second ducts **64**, **74** extend into the common channel **80**. Each of the outlet ends **64***e*, **74***e* is angled such that the length of ducts **64** and **74** diminishes along the direction of the airflow **84**. In other words, the outlet ends **64***e*, **74***e* are angled away from the fan unit **90** so that they do not facilitate the airflow **84** moving into the first and second ducts **64**, **74**. When the outlet ends **64***e*, **74***e* are adjacent to and aligned with each other along the direction of the airflow **84**, preferably the angled bottoms of the outlet ends **64***e*, **74***e* are on a common plane.

Since the first duct **64** is longer than the second duct **74**, its outlet end **64***e* is disposed upstream of the outlet end **74***e* of the second duct **74** so that its outlet end **64***e* is closer to the fan **90** than the outlet end **74***e*. Moreover, as clearly shown in FIG. **8**, the outlet end **74***e* is disposed substantially in the diverging section **80***d*. However, preferably the upstream edge of the outlet end **64***e* is disposed directly across from the point of the "v" at **80***e* so that when the airflow **84** passes it, the airflow **84** has the fastest speed/velocity and therefore the lowest pressure at the upstream edge of the outlet end **64***e*. Alternatively, the outlet end **64***e* can be disposed partially in the diverging section **80***d* and partially in the converging section **80***c*.

When energized, the fan unit **90** generates the airflow **84** in the common channel **80**. The airflow **84** has an initial speed/velocity and pressure at the intake end **80***a* of the common channel **80**. As the airflow **84** passes through the converging

section **80***c*, its speed/velocity increases while its pressure decreases. In contrast, as the airflow **84** passes through the diverging section **80***d*, its speed/velocity decreases while its pressure increases. The outlet ends **64***e*, **74***e* are positioned in the common channel **80** so that when the airflow **84** passes them, the low pressure in the channel resulting from the Venturi effect, is lower than the pressure inside the first and second oven cavities **60***a*, **70***a*. This creates a vacuum in each of the outlet ends **64***e*, **74***e* so that air is drawn from the first and second oven cavities **60***a* and **70***a* through the first and second ducts **64**, **74**, respectively. The combined airflow is then vented out of the oven **10** at the exhaust end **80***b*.

Thus, while there have shown, described and pointed out fundamental novel features of the invention as applied to a preferred embodiment thereof, it will be understood that various omissions and substitutions and changes in the form and details of the devices illustrated, and in their operation, may be made by those skilled in the art without departing from the spirit of the invention. For example, it is expressly intended that all combinations of those elements and/or method steps which perform substantially the same function in substantially the same way to achieve the same results are within the scope of the invention. Moreover, it should be recognized that structures and/or elements and/or method steps shown and/or described in connection with any disclosed form or embodiment of the invention may be incorporated in any other disclosed or described or suggested form or embodiment as a general matter of design choice. It is the intention, therefore, to be limited only as indicated by the scope of the claims appended hereto.

What is claimed is:

1. An appliance comprising:

a housing defining therein an airflow channel which is in flow communication with outside of the appliance, the airflow channel comprising a common channel, the common channel defining therein an airflow direction and comprising a diverging section with a cross section which increases in size in the airflow direction, and a converging section with a cross section which decreases in size in the airflow direction, the converging section being upstream of and next to the diverging section;

a first heating unit disposed in the housing, the first heating unit defining therein a first cavity;

a second heating unit disposed in the housing, the second heating unit defining therein a second cavity;

a first duct through which the first cavity is in flow communication with the common channel, the first duct comprising a first outlet end disposed at least partially in the diverging section;

a second duct through which the second cavity is in flow communication with the common channel, the second duct comprising a second outlet end disposed in the diverging section; and

a fan in flow communication with the common channel,

wherein when energized, the fan generates an airflow in the common channel to create a Venturi effect in the diverging section so that exhaust air in the first and second cavities is drawn into the common channel.

2. The appliance of claim **1**, wherein the first duct has a length longer than a length of the second duct, the first outlet end being disposed upstream of the second outlet end.

3. The appliance of claim **1**, wherein the housing comprises a bottom wall, the common channel being defined in part by the bottom wall.

4. The appliance of claim **3**, wherein the housing further comprises a front, the common channel further comprising an exhaust end terminating at the front.

5. An appliance comprising:

a housing defining therein an airflow channel which is in flow communication with outside of the appliance, the airflow channel comprising a common channel, the common channel comprising an intake end, an exhaust end, a diverging section disposed between the intake end and the exhaust end and comprising a cross section which increases in size in a direction from the intake end to the exhaust end, and a converging section disposed between the intake end and the exhaust end and comprising a cross section which decreases in size in the direction from the intake end to the exhaust end, the converging section being upstream of the diverging section, the converging section and the diverging section meeting at a common line;

a first oven disposed in the housing, the first oven defining therein a first oven cavity;

a second oven disposed in the housing, the second oven defining therein a second oven cavity;

a first duct through which the first oven cavity is in flow communication with the common channel, the first duct comprising a first outlet end terminating in the diverging section;

a second duct through which the second oven cavity is in flow communication with the common channel, the second duct comprising a second outlet end terminating in the diverging section; and

a fan in flow communication with the common channel and disposed upstream of the first and second outlet ends,

wherein when energized, the fan generates an airflow in the common channel to generate a Venturi effect in the diverging section proximate the first and second outlet ends, so that exhaust air in the first and second oven cavities is drawn into the common channel through the first and second ducts.

6. The appliance of claim **5**, wherein the first duct has a length longer than a length of the second duct, the first outlet end being disposed upstream of the second outlet end.

7. The appliance of claim **5**, wherein the converging section and the diverging section are defined in part by an angular guide member.

8. The appliance of claim **7**, wherein the guide member is substantially V-shaped.

9. The appliance of claim **7**, wherein the housing comprises a bottom wall, the common channel being defined in part by the bottom wall, the guide element being supported by the bottom wall.

10. The appliance of claim **9**, wherein the guide member is sandwiched by an insulation retention member for the second oven and the bottom wall, the guide member comprising a first surface facing the second oven, a second surface facing away from the second oven, and a sealing element disposed on each of the first surface and the second surface.

11. The appliance of claim **10**, wherein the housing further comprises a front, the exhaust end terminating at the front.

12. The appliance of claim **5**, wherein each of the first and second outlet ends extends into the common channel, at least one of the first and second ducts having a length which diminishes along a direction of the airflow.

13. The appliance of claim **12**, wherein the housing comprises a back wall, the fan being disposed adjacent to the back wall.

14. The appliance of claim **13**, wherein the fan comprises an outlet which is disposed adjacent to the intake end.

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